

The Biology of the North American Crane Flies (Tipulidæ Diptera) III. *The Genus Ula* Haliday

CHARLES PAUL ALEXANDER,
ITHACA, N. Y.*

INTRODUCTION

The genus *Ula* was erected by Haliday (Entomological Magazine, Vol. 1, p. 153, 1833) for the species *mollissima*, nov., which is now recognized as being the same as the *Limnobia macroptera* of Macquart (Recueil Soc. Sc. Agricult., Lille, p. 158, 1826).

The genus includes six described species, *macroptera* Macquart, the genotype, *sororcula* Zetterstedt, and *bolitophila* Loew, of Europe; *elegans* Osten Sacken and *paupera* Osten Sacken of the United States; and *javanica* Alexander of Java. The series of North American material that I have had for study render it probable that *paupera* Osten Sacken (Mon. Dipt. N. Am., vol. 4, pp. 277, 278, 1869) is the same species as *elegans* Osten Sacken (l. c., pp. 276, 277). The insect varies greatly in its body coloration and in the intensity of the pattern on the wings. It seems possible, moreover, that the three European species are merely variations of a single species, but this question cannot be decided at this time.

Osten Sacken in 1859 (Proc. Acad. Nat. Sci. Phila., p. 199) placed this genus in the tribe *Pedicini* (as *Pediciæformia*) and in 1869 (Mon. Dipt. N. Am., vol. 4, p. 274 to 278) still retained it in this tribe (as *Amalopina*). It has been left in this tribe by all subsequent workers, but the study of the immature stages shows that the reference is quite erroneous. The genus *Ula* should be placed in the *Limnophilini* close to *Ulomorpha* Osten Sacken. The characters of the *Pedicini* (i. e., larva with the anterior margin of the submental region transverse, the caudal end of the body with but two lobes; pupa with the spiracles short, the tips expanded and

* Contribution from the Limnological Laboratory of the Department of Entomology in Cornell University.

truncated) are quite lacking in *Ula*, the larva possessing five lobes around the stigmal field, the mouth-parts similar to those of *Limnophila*, the pupa essentially *Limnophiline*, etc.

Stannius (Beitr. zur Entomol., vol. 1, p. 205, 1826) was the first to give us any information on the immature stages of any member of this genus. He states that the larva of *Ula macroptera* (as *pilosa* Schummel) lives in species of *Agaricus*, and remarks that the larva is very similar to that of *Limnobia xanthoptera* Meigen.

Perris (Note pour servir a l'histoire de la *Cylindrotoma macroptera* Macquart, in Notes pour servir a l'histoire des metamorphoses de diverses especes de Dipteres; Ann. Soc. Ent. France, vol. 7, pp. 337 to 341, 1849) gives a brief description and unsatisfactory figures of this same species. He describes the caudal end of the body as having but four lobes, two being lateral and two ventral; no mention is made of the median dorsal lobe, and it may have been overlooked or it may be very reduced in this species; the caudal or inner aspect of these lobes that surround the stigmal field are provided with small chitinized pieces which, as the author suggests, may serve as points of attachment for the muscular fibres. His account in part may be translated as follows: The fungus in which the larvæ were found was *Hydnum erinaceum* Bull., which grows on the trunks of living oak-trees. The larvæ are gregarious and frequent galleries in the fungus along which they progress by means of their mandibles, which move transversely to their bodies, by their ambulatory feet, by their short hairs and the lobes of the last segment. They were found in the month of November in the Mont-de-Marsan, and a month later they were going into the earth where they transformed as pupæ. These latter quite resemble the pupæ of *Limnophila*, having the same structure, same size, the same hooks, differing only in the color, which is uniformly testaceous, though the breathing horns, instead of being very recurved, are scarcely sinuous. When the time of the last metamorphosis has come, that is about in the months of February and March, the nymph raises itself by means of the spines, comes to the surface of the earth and places itself in position; soon the head and thorax split longitudinally, and it is by this movement that the adult escapes, leaving the exuvia of the nymph fixed in the earth.

In his original description of *Ula bolitophila* (Besch. Eur. Dipt., vol. 1, pp. 4, 5, 1869) Loew remarks that some of the material upon which the species was based was from Krain, Austria, where it was bred from larvæ dwelling in a fungus on beech trees.

On September 15, 1912, at Gloversville, Fulton County, New York, I took a fleshy species of *Fomes* (*Polyporus*) growing on a stump near the earth. This contained about 35 larvæ of *Limnobia cinctipes* Say, and many larvæ of *Ula elegans* Osten Sacken. The larvæ of these crane-flies infested the upper layers of the fungus and had reduced the surface to a semi-liquid state. At the end of a week the whole mushroom was decayed and semi-liquid. The record of proceedings as it appears in my field-notes is as follows:

"Sept. 28, 1912, at Ithaca, N. Y. The specimens were placed in jars containing sand, which took up the liquids produced by the disintegration of the mushroom and provided a place for pupation.

"Oct. 4, 1912. All of the above larvæ when examined were found to be alive and active.

"Oct. 14, 1912. Four *Ula* emerged today. This limits the pupal period to not longer than ten days."

The insects continued to emerge in large numbers until the 27th of October, when the remaining pupæ were killed and preserved in alcohol. At this time they were very dark-colored and evidently nearly ready to emerge as adults. The larval movements may be described as follows: At each movement forward the terminal segment of the larva partly telescopes into the subterminal and is thrown back violently at each forward movement. At other times the larval motions are very actively to-and-fro, eel-like. The associates of *Ula* in the fungus were larvæ of *Limnobia cinctipes* Say, and a much lesser number of *Limnobia triocellata* Osten Sacken.

After transforming to the adult condition, the pupal skins are found attached to the sand by the apical one-half or the extreme caudal end of the body, often standing up perpendicularly to the surface, the exuvixæ being very conspicuous.

The adult flies are most common in the spring and fall, but are rarely if ever taken during the season of midsummer. They are especially numerous in cool, shaded gorges and ravines, and may be swept from beds of low vegetation, such as ferns, ground-hemlock

(*Taxus canadensis*), etc. The following records taken from my distribution sheets indicate the geographic and seasonal range of the species. *Maine*: Fort Kent, Aroostook Co., August 17-19, 1910 (Johnson); August 28, 1913 (Osborn). Orono, Penobscot Co., June 6, 1913 (Alexander). *New Hampshire*: White Mountains, July, 1863 (Osten Sacken's type of *elegans*). *New York*: Old Forge, Herkimer Co., August, 1905, at trap-lanterns (Needham). Pinnacle Mountain, altitude 2000 feet, September 16, 1911; Woodworth's Lake, altitude 1660 feet, August 22, 1910; Johnstown, altitude 600 feet, May 13, 1914; these stations in Fulton Co., collected by the author. Bear Creek, Freeville, Tompkins Co., May 29, 1913; Renwick Flats, May 8 to 14, 1912; Coy Glen, April 27, 1912; these stations in Tompkins Co., collected by the author. *New Jersey*: West Orange, Waverly, Forest Hill, May; Hemlock Falls, August; this material collected by Weidt, in the collection of Dr. Dietz. *District of Columbia*: Washington (Osten Sacken's type of *paupera*). *Virginia*: Fairfax Co., Rosslyn, August 25, 1912 (Knab and Malloch). *Wisconsin*: Price Co., August 13, 1897 (part of the W. M. Wheeler collection in the American Museum).

The following observations upon the mating habits are given: May 14, 1912. At Renwick, Ithaca, N. Y., this species was swarming about 4:30 P. M.; many were "in cop" on the leaves of skunk-cabbage, *Symplocarpus fœtidus*. There were about 15 or 20 individuals in a swarm, which takes place about a foot above the skunk-cabbage leaves. Copulation is rather firm and they fly for short distances still united. In copulation they usually rest on the upper surface of the leaves with all the legs on the support. Swarms were noted consisting of from 1 to 20 individuals, and usually from 6 to 12 inches above the leaves. At this time the only adult crane-fly found with *Ula* was *Limnophila ultima* Osten Sacken, which occurred in small numbers.

DESCRIPTION OF THE IMMATURE STAGES

ULA ELEGANS Osten Sacken.

Ula elegans Osten Sacken. Monographs of the Diptera of North America, part IV, pp. 276, 277, 1869.

LARVA

(Plate I, Fig. 2)

Length: Maximum, 8.5-11.9 mm.; diameter, 1.4-1.8 mm.

Color of the larva dull white, the head-capsule very dark brownish black, shiny. The caudal end of the body is produced into five blunt teeth of which the dorsal one is median in position, two lateral teeth slightly above the plane of the body, and two ventral teeth directed laterad; the dorsal tooth is more blunt than the others. The inner or caudal face of each tooth is adorned with a conspicuous brownish black mark; the mark of the lateral tooth (see Plate I, Fig. 3) is large, its outer end conforming with the shape of the teeth, rounded at the tip, inner end concave, not touching the stigmata, separated from the stigma by a space about equal to the light brown outer portion of the spiracle. Ventral teeth with the black mark shaped as follows: Elongate, the dorsal outer face gently convex, the inner ventral face gently convex on the terminal portion, concave near the dorsal end; its dorsal or inner end is separated from the spiracle of the same side by a distance a little less than the diameter of the spiracle. Dorsal tooth with the mark small, elongate-oval. A fringe of delicate blackish hairs around the caudal end on the outside of the black marks and running inward between the teeth; these hairs are longer and more prominent at the ends of the teeth. Stigmata almost round, very widely separated from one another, the space between being about three times the diameter of a single spiracle. Interstigmatal disk pale with an indistinct mark shaped as in the figure.

Head-capsule rather oval. Antennæ (see Plate I, Fig. 5) inserted on the sides of the front, just laterad of the caudal margin of the clypeo-frontal sclerite; basal segment rather short, cylindrical, more widened at its base, the tip with two small conical lobes that are almost transparent. Clypeo-frontal sclerite (see Plate I, Fig. 7) broad at the base, the cephalic margin broadly rounded,

with a small rounded protuberance on the anterior margin, widely separated from one another, this being the anterior end of the epipharynx underneath; the sclerite is yellow with a broad band across the middle and a second one across the caudal margin; the middle band indicates the position of the epipharynx beneath (see Plate I, Fig. 8). Maxilla large, the outer lobe conspicuous, enlarged cylindrical with a small knob at the tip. Mandibles (see Plate I, Fig. 6) long and slender with a long, strong apical point and from three to four smaller lateral teeth on the inner face near the tip, these teeth gradually smaller from the tip toward the base and thus presenting a somewhat comb-like appearance. Submental region (see Plate I, Fig. 4) moderately well-developed, the median split behind quite deep; the cephalic margin with subequal teeth arranged regularly, four on either side, and a much smaller apical tooth occupying the terminal notch.

PUPA

(Plate I, Fig. 1)

Male. Head viewed from beneath: Mouth parts not prominent. Maxillæ appearing as two lobes, contiguous on the median line of the body, the palpi very long, extending laterad underneath the eye to the antennæ. Labium small, in the shape of a caudal lobe behind the maxillæ. No spines on the front, but there are several dark lines on the space between the eyes that have the appearance of long appressed hairs, the tips directed backward. Antennæ not prominent, rather widely separated at the base, ending just before the origin of the wing-pad. A small bilobed protuberance shows between the antennal bases.

Thorax with the pronotal breathing horns directed cephalad and laterad, rather pointed. Thoracic dorsum without lobes or spines. Tips of the metatarsi about on a common level, the fore pair of legs ending slightly beyond the tips of the other two pairs. Legs long, extending about midlength of the fifth abdominal segment. Wing-pad ending just beyond the tip of the first abdominal segment.

Abdominal tergites with transverse rows of scattered setigerous punctures, which rows are fairly well defined on the anterior segments, especially on the first segment, where there are some 20 to

25 in a row. Beginning on the second tergite, there is a broad transverse band of subchitinized, shagreened texture; on the second to fourth segments they are subbasal, but the last two are on the ends of the segments, one on the fourth, the last on the fifth. The fifth and sixth tergites have the setigerous punctures quite abundant and scattered, except on the basal third, which is bare. The seventh segment bears four obtuse indistinct lobes, two on either side of the median line. The eighth tergite is rounded, with a deep median notch. The eighth sternite shows the genitalia within, consisting of lobes that bear from 12 to 15 strong chitinized points on the inner caudal face. The four basal sternites are hidden by the elongate leg-pads; the sixth with a sub-basal ring of the shagreened appearance described above, the abdomen beyond this ring is provided with numerous scattered hairs, in front of it without hairs.

Mouth parts, wings and legs, rather dark brown. The thoracic dorsum and abdomen are rather light yellowish brown. The pronotal breathing horns are very conspicuous, dark brown basally, passing into a bright light yellow on the apical third or quarter. The mesonotal præscutum retains its light coloration even in old pupæ and those preserved in alcohol.

Length: Total, 6.4-7 mm.

Dextro-sinistral width at the wing-pad: 1.2-1.3 mm.

Dorso-ventral depth at the wing-pad: 1.2-1.6 mm.

Larva and pupa described from material preserved at Ithaca, N. Y., on October 15, 1912.

EXPLANATION OF THE PLATE

- Figure 1. Pupa, lateral aspect.
- Figure 2. Larva, lateral aspect.
- Figure 3. Larva, caudal end of abdomen, caudal aspect.
- Figure 4. Larva, submental region, ventral aspect.
- Figure 5. Larva, antenna, dorsal aspect.
- Figure 6. Larva, mandible, ventral aspect.
- Figure 7. Larva, clypeo-frontal region, dorsal aspect, showing the antenna.
- Figure 8. Larva, clypeo-labral region, ventral aspect showing the epipharynx.